REMARKS

Applicants respectfully traverse and request reconsideration.

New claim 30 has been added by amendment. Paragraphs 22 and 28 have been amended to correct typographical errors. No new subject matter has been added in the aforementioned amendments.

Claims 1–11, 13-15, 19 and 23-29 stand rejected under 35 U.S.C. § 103(a) as being unpatentable in view of U.S. Patent Publication No. 2005/0134588A1 to Aila et al. ("Aila") in view of U.S. Patent No. 5,579,455 to Greene et al. ("Greene").

Claim 1 includes language that requires, among other things, "comparing a tile Z value range of a tile with a hierarchical Z value range and a stencil code" and "determining whether to render a plurality of pixels within the tile based on the comparison of the tile Z value range with the hierarchical Z value range and the stencil code."

The current Office Action states that Aila teaches a tile Z-min and tile Z-max and further determines "whether to render a plurality of pixels within the tile [] based on depth information (p. 1, ¶ 5-6)." (Office Action, pp. 2-3). The Action admits that "Aila et al. fails to explicitly teach a hierarchical Z value range for which to compare said previously disclosed Z value range with." (Office Action, p. 3). Greene allegedly provides this limitation in its use of depth buffer 502. (Office Action, p. 4). According to the Office Action, the depth buffer 502 contains Z-min and Z-max values "for a given element, e.g., Fig. 5A element 512 (tile)" and this represents a depth range. (*Id.*). The Office Action states that the combination of Aila and Greene would "allow for quicker rejection of hidden geometry [] thus improving overall efficiency of said system." (Office Action, p. 4). As a matter of clarification, the Office states that Aila (and not

Greene) was introduced to address the limitation of a tile having a respective Z-min and Z-max value. (Office Action, p. 8).

Applicants, however, disagree. Aila appears to teach either the comparison of a Z-max value for a tile to a triangle z-value for the purpose of determining whether the triangle is hidden or visible or the comparison of z-values of two polygons to determine which polygon is in front of the other at each pixel location. Greene appears to teach comparing a tile Z-min value and a tile Z-max value of a tile to a single value of a primitive (the nearest depth value of the primitive) to help determine if the primitive is hidden or partly visible. Thus, to the extent Aila and Greene can be compared to Applicants' claim 1, each of Aila and Greene essentially perform the same task: comparing at least one z-value of a tile to z-values of a triangle. At no point does either reference teach, suggest, or contemplate the comparison of a tile Z value range to a hierarchical Z value range.

Aila appears to teach that tiles can be conveniently defined by Z-min and Z-max values. (Aila, p. 4, ¶ 54). In discussing a method and processor for image processing in which tiles are determined to be either fully lit, fully in shadow or a potentially boundary tile (*see* Abstract, Fig. 4), Aila suggests that triangles (and the pixels that comprise the triangles) must be compared to information known about the tile. With reference to FIG. 6, Aila appears to teach that a vertex shader 611 applies transformations and perspective projection to a triangle's vertices (p. 6, ¶ 78), that a coarse rasterizer 612 converts the triangles into pixels of the triangle on the tile level (*Id.*), and that an early occlusion test unit 613 determines whether these pixels of each triangle are hidden or visible (*Id.*, p. 7, ¶ 84). Using the results of the early occlusion test unit 613, Alia determines whether a tile is fully lit, fully in shadow or a potentially boundary tile. (pp. 7-8, ¶ 84). The early occlusion test unit 613 using the Z-max value of the tile to perform its occlusion

culling. (p. 7, ¶ 84). In other words, Aila appears to teach that the Z-max value for a tile is compared to a triangle z-value to determine if the pixels of a triangle are hidden or visible and thus whether a triangle is hidden with respect to a tile or whether it intersects a tile. (p. 6, ¶ 78, pp. 7-8, ¶ 84).

In another portion of the cited publication, Aila explains a prior art method for drawing polygons. (Aila, p. 1, ¶¶ 5-6). This method requires a determination of which polygon is the foremost for selecting the color of pixels on the display. (p. 1, ¶ 5). Because each pixel associated with a polygon has a z-value, this z-value can be compared to a corresponding value in a z or depth buffer. The z-values in the z or depth buffer represent the z-value for the previously stored polygon associated with the same pixel. (p. 1, ¶ 6). If the new z-value is smaller that the previously store z-value, then the new polygon is in front of the old polygon at that pixel location and the color of that pixel associated with the new polygon should be used. (*Id.*) Alternatively, the new polygon is behind the old polygon at that pixel location, and the color of the pixel associated with the old polygon should be maintained. (*Id.*). In other words, in this embodiment, Aila teaches comparing z-values of a previously-processed polygon with z-values of an incoming polygon to determine which polygon is "in front" of the other for the purpose of rendering a color for each pixel.

In summary, Aila appears to teach the use of the tile Z-min value for the sole purpose of defining or identifying tiles. Aila appears to compare a Z-max value of a tile to a Z value of a triangle to determine if the triangle is hidden or visible in the tile. Alternatively, Aila appears to compare z-values associated with a new and an old polygon to determine which polygon is at the forefront for each pixel.

Greene does not appear to solve the deficiencies of Aila. Greene appears to teach that Z-min and Z-max values are associated with elements of a depth buffer where the elements may be capable of representing a tile of pixels. (Greene, Col. 10, l. 8 – Col. 9, l. 12). The Office Action, itself, admits that Greene's z-min and z-max values are z-min and z-max values <u>of a tile</u>. (Office Action, p. 4, ll. 13-15). In order to "quickly reject most of the hidden geometry in a model" and to exploit "the spatial and temporal coherence of the images being generated" (Greene Abstract, p. 4 Office Action), Greene teaches the use of a "prove hidden" algorithm for primitives. (Fig. 19A, Col. 17, ll. 9-40). The algorithm provides that the nearest depth or z-value of a primitive is compared to the appropriate tile Z-max value. (*Id.*). If the tile Z-max value in the depth buffer is smaller than the nearest depth value of the primitive, then the primitive is hidden. (*Id.*). If, however, the tile Z-max value is not smaller than the nearest depth value of the primitive, then the tile Z-min value is compared to the nearest depth value of the primitive. If the tile Z-min value is greater than the nearest depth value of the primitive, then the primitive is at least partly visible. (*Id.*). In other words, Greene teaches <u>comparing a tile Z-min value and a tile Z-max value to a single value of a primitive</u> (the nearest depth value of the primitive) to help determine if the primitive is hidden or partly visible.

Thus, any combination of Greene and Aila would necessarily be focused on <u>comparing tile z-values with a z-value of a primitive</u> as this is what each reference advocates and teaches. The benefit and necessity of this comparison is, as discussed above, to determine if a triangle is visible in a tile. Applicants are unable to discern any motivation to perform any other sort of comparison as the only z-value ranges in each of the references are tile z-value ranges, and because incoming triangles must be evaluated to determine if they are hidden or partly visible.

Assuming, solely for the sake of argument, that Greene's tile z-value range is a hierarchical Z-value range (a position not taken by Applicants or by the current office action), Applicants note that both references appear to teach the same thing: comparing a z-value range to a triangle to determine visibility of the triangle. In this hypothetical example, Aila's z-value range is naturally associated with a tile while Greene's z-value range is allegedly a hierarchical z-value range and any combination of Aila and Greene would necessarily take a z-value associated with an incoming triangle and compare it to the tile z-value range of Aila and to the allegedly hierarchical z-value range in Greene. No combination would, as suggested by the Examiner, compare Aila's tile z-value range to Greene's alleged hierarchical z-value range because: (1) neither reference discloses how such ranges could meaningfully be compared; (2) the Office Action does not disclose how such ranges could meaningfully be compared; and (3) any such comparison would appear ignore the incoming triangle's z-value and not provide the benefits taught in Aila and Greene. Applicants reassert that the incoming triangle is the "thing" that needs to be compared to one of Aila's or Greene's z-value range as both Aila and Greene teach using such a comparison to determine the visibility of the triangle. Thus, contrary to the Examiner's statement that such a comparison would "allow for quicker rejection of hidden geometry [] thus improving overall efficiency of said system, the combination of Aila and Greene would lead to no rejection of hidden geometry as the geometry (i.e., the triangles) would never be compared to a z-value range and thus the system would have no efficiency. Thus, even if Applicants have improperly suggested that Greene does not teach hierarchical z-value ranges, no combination of Aila and Greene would render Applicants' claim 1 obvious.

Addressing the Office Action's assertion that although while Greene discloses "a particular way of performing a comparison[,] this is not the same as disclosing that only said

particular way is performed" (Office Action, p. 9), Applicants reassert the relevant remarks above directed to the observation that any combination of Aila and Greene would be inoperable for each reference's intended purpose of rejecting hidden geometry (triangles) as no triangle z-value would be compared to anything. Thus, no motivation has been provided by the Office Action to modify Greene and depart from the only teachings found in Greene: comparing a triangle's z-value to a max-Z and min-Z value in a depth buffer for the purpose of determining whether the triangle is hidden or partly visible.

For each of the above-stated reasons, claim 1 is believed to be in proper condition for allowance.

Claims 23, 27 and new claim 30 contain language that is similar to claim 1 to the extent that each claim compares two z-values of a tile to a hierarchical z-value range (e.g., claims 27 and 30) or to two z-values of a cache (e.g., claim 23). Thus, for the same reasons articulated above, claims 23, 27 and 30 are also in condition for allowance.

Claim 8 contains language that requires the claimed stencil code to be "a multiple-bit indicator which specifies a relation of a plurality of stencil values in the tile relative to a background value." The Office Action cites Aila p. 9, ¶¶ 102 and 106 as allegedly teaching this limitation. (Office Action, p. 5). However, this is incorrect and improper as these paragraphs are directed to: (1) use a common sample point for a plurality of tiles so that each of these tiles can share a common classification (e.g., tile lit, tile in shadow, or tile as potential boundary tile) (¶ 102) and (2) use of a stencil buffer for storing a shadow mask in one embodiment, and use of a color buffer to modulate the contents of an image of the rendered scene where a stencil buffer is not used in a second embodiment (¶ 106). At no point does either of these two paragraphs touch on the above-referenced claim language.

The Office Action states that paragraph 102 allegedly teaches the use of a multiple-bit indicator as a stencil code. (Office Action, p. 5). However, as noted above, paragraph 102 is directed to allowing multiple tiles share a common sample point for the purpose of tile classification. As understood by Applicants, this allegedly increases efficiency as step 407 in the method for image processing can carry out the shadow volume algorithm for one point and determine if the point is lit. The result will then apply to all of the multiple tiles as each of these tiles have a common sample. Nothing in paragraph 102 appears to teach or suggest a multiple-bit indicator for a stencil code.

Similarly, the Office Action states that paragraph 106 teaches that the stencil code specifies a relation of a plurality of stencil values in the tile relative to a background color (e.g., no color) value. (Office Action, p. 5). The Examiner further clarifies that "[i]t is noted that the respective claim langu[ag]e is silent as to an actual value that defines said background value" or "stencil value". Notwithstanding the above alleged observation, Applicants note that paragraph 106 of Aila is merely directed to using a stencil buffer to store a shadow mask or to using a color buffer to modulate the contents of an image of the rendered scene. The reference is silent as to a stencil code, to a stencil value and to a background value and to the claimed "stencil code" that "specifies a relation of stencil values in the tile relative to a background value."

For each of these reasons, claim 8 is in proper condition for allowance.

Applicants further note that claim 30 also requires "generating a signal indicating that a detailed depth test is not required because all pixels of the tile are known to be visible in the hierarchical Z plane." Applicants are unable to find any teaching or suggestion in either Aila or Greene that anticipates this claim limitation. Applicants also submit that no combination of Aila

or Greene renders this limitation obvious. For this reason, in addition to those stated above with respect to claim 1, claim 30 is also believed to be in proper condition for allowance.

Claims 2-7, 9-11, 13-15, 19, 24-26 and 28-29 are dependent upon allowable base claims and are believed to be in proper condition for allowance for at least the same reason as their respective base claims. For example, claim 6 contains the same or similar language as claim 8 and is believed to be allowable for at least the same reasons as claim 8. Each of the aforementioned dependent claims are also believed to add additional novel, non-obvious and patentable subject matter.

Applicants respectfully submit that the claims are in condition for allowance and respectfully request that a timely Notice of Allowance be issued in this case. The Examiner is invited to contact the below listed attorney if the Examiner believes that a telephone conference will advance the prosecution of this application.

Respectfully submitted,

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